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ISAS_V4.1b :
Description of the method and user manual.

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Historique

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F. Gaillard	Création du document – V4 beta	03/02/2007
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Content

1 Introduction

ISAS (In Situ Analysis System) is an analysis tool for the temperature and salinity fields, originally designed for the synthesis of ARGO dataset, it has been tested for the first time on the POMME area in the North-East Atlantic (2000). It is developed and maintained at LPO (Laboratoire de Physique des Océans) within the ARIVO project and has been made available to the Coriolis datacenter. The analysis is performed on the daily datasets prepared by Coriolis for the various operational users. The background and statistical information required to complement the observations are provided with the software, as part of the configuration (Charraudeau et Gaillard, 2007). For each analysis date, the results are provided as two NetCDF files, one holding the data and analysis residuals, the other holding the gridded fields and estimation error, expressed as percentage of a priori variance. This document describes the method and how it is implemented within ISAS. The main steps of the process are detailed and examples of configuration files are provided.

2 Method and configuration

2.1 Estimation method

ISAS uses estimation theory for mapping of a scalar field on a regular grid from sparse and irregular data (Bretherton et al.,1976). The interpolated field, represented by the state vector x, is constructed as the departure from a reference field values at the grid points x^f. This reference is derived from previous knowledge (climatology or forecast). Only the unpredicted part of the observation vector, or departure from the reference field at the data points, called innovation, is used:

$$d = y^o - x^f$$

The analyzed field x^a, is obtained as a linear combination of the innovation, and is associated with a covariance matrix P^a.

$$x^a = x^f + C_{ao}\left(C_o + R\right)^{-1} d\,,$$
$$P^a = P^f - C_{ao}\left(C_o + R\right)^{-1} C_{ao}^T \qquad \textit{(eq. 1)}$$

It should be noticed that this formalism provides at the same time an estimate of the misfit between observations and analysis, also called analysis residuals:

$$y^o - y^{ao} = R\left(C_o + R\right)^{-1} d$$

C_{ao} is the covariance matrix between analyzed points and data points, C_o is the covariance matrix between data points and R is the error covariance matrix. It combines the measurement error and the representativity error. The error on the estimation is given by the diagonal of the P^a matrix, usually normalized by the a priori variance.

$$\frac{\sigma_{ei}^2}{\sigma_{xi}^2} = 1 - \left(\frac{C_{ao}\left(C_o + R\right)^{-1} C_{ao}^T}{\sigma_{xi}^2}\right)_{ii}$$

2.2 Statistical information

Statistical information on the field and data noise are introduced through the covariance matrices that appear in equation 1. We assume that the covariances of the analyzed field can be specified by a structure function modeled as the sum of two gaussians, the first term (i = 1) corresponding to the large scale field (LS), the second (i = 2) to the mesoscale (MS):

$$C(dx,dy,dt) = \sum_{i=1}^{2} \sigma_i^2 \exp-\left(\frac{dx^2}{2L_{ix}^2} + \frac{dy^2}{2L_{iy}^2} + \frac{dt^2}{2L_{it}^2}\right)$$

where dx, dy, dt are the space and time separation, L_{ix}, L_{iy}, L_{it} the corresponding e-folding scales. The weight given to each ocean scale is controlled by the variances σ_i^2.

The total variance is computed as the variance of the anomaly relative to the monthly reference field. It is considered as the sum of four terms:

$$\sigma_{tot}^2 = \sigma_{LS}^2 + \sigma_{MS}^2 + \sigma_{UR}^2 + \sigma_{ME}^2$$

where σ_{LS}^2 and σ_{MS}^2 are the two terms appearing in the equation for the covariance structure. The remaining sum $\sigma_{UR}^2 + \sigma_{ME}^2$ is the total error variance: σ_{ME}^2 corresponds to the

measurement errors and σ_{UR}^2 represents small scales unresolved by the analysis and considered as noise, sometimes called representativity errors. A unique σ_{ME}^2 profile has been computed from the measurement errors of the standard database and substracted from the total variance to obtain the ocean variance (first three terms of the sum). The ocean variance is adjusted to remain larger than σ_{ME}^2 and can be multiplied by a factor to account for the under-sampling of the ocean variability. We express the variances associated to each scales as a function of the ocean variance by introducing normalized weights:

$$\sigma_{LS}^2 = w_{LS}\sigma^2$$

$$\sigma_{MS}^2 = w_{MS}\sigma^2$$

$$\sigma_{UR}^2 = w_{UR}\sigma^2$$

$$w_{LS} + w_{MS} + w_{UR} = 1$$

The free parameters of the system are the weights that define the distribution of variance over the different scales. The error matrix combines the measurement error and the representativity error due to unresolved scales, it is assumed diagonal, although this is only a crude approximation since both errors are likely to be correlated for measurements obtained with the same instrument, or within the same area and time period.
The large scale lengths are taken isotropic and equal to 300km, the target Argo resolution, the corresponding time scale is set to 3 weeks. The meso-scale length is proportionnal to the Rossby Radius computed from the annual climatology. In the equatorial band, this value is bounded by the large scale length in the zonal direction, and by the length scale of the adjacent zones in the meridional direction. At high latitudes, it is bounded by the resolution of the estimation grid.

2.3 The datasets

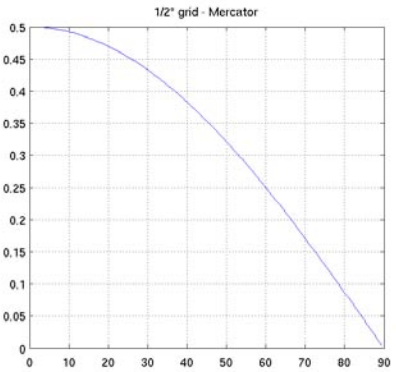
We briefly describe here the characteristics of the data types taken into account at the moment. These dataset have different accuracy, resolution and sampling that depend mostly on the sensor and on the storage and transmission system used.
Temperature and salinity measurements are obtained from autonomous instruments, drifting or anchored or from instruments deployed with a ship. The data are transmitted in real time by satellite, or in delayed mode. The main characteristics of the most common instruments are given below.

- **Profiling floats**: The autonomous floats are part of the ARGO program, they collect vertical profiles of temperature and salinity as a function of pressure between their maximum pressure (usually 2000 dbars) and the surface. At the end of the profile that takes nearly 5 hours, the profiler transmits the data to a satellite and dives toward its parking depth (1000 dbars), waiting for the next cycle (10 days later). Nominal accuracy of the data is assumed to be 0.01°C and 0.01 PSU. At present time a vertical profile is described by approximately 100 pts.
- **XBT**: An eXpendable BathyThermograph is launched from a steaming ship. It measures temperature (and salinity in the case of XCTD) the measurement depth is deduced from the XBT fall rate. The accuracy is 0.1°C and most XBT reach 800 m.
- **CTD**: This high quality measurement is obtained from a research vessel in the context of a scientific cruise. Pressure and temperature sensors are carefully calibrated and water samples are taken to adjust the salinity measurement. Standard procedure were defined for the WOCE experiment, they lead to accuracies of 0.001°C and 0.001 PSU.
- **Time series:** Time series of pressure, temperature and salinity are recorded at high time resolution (hours) from sensors installed on fixed points (mooring) or drifting

buoys. The measurement depth is usually constant. The sensors are similar to those used on the profiling floats.

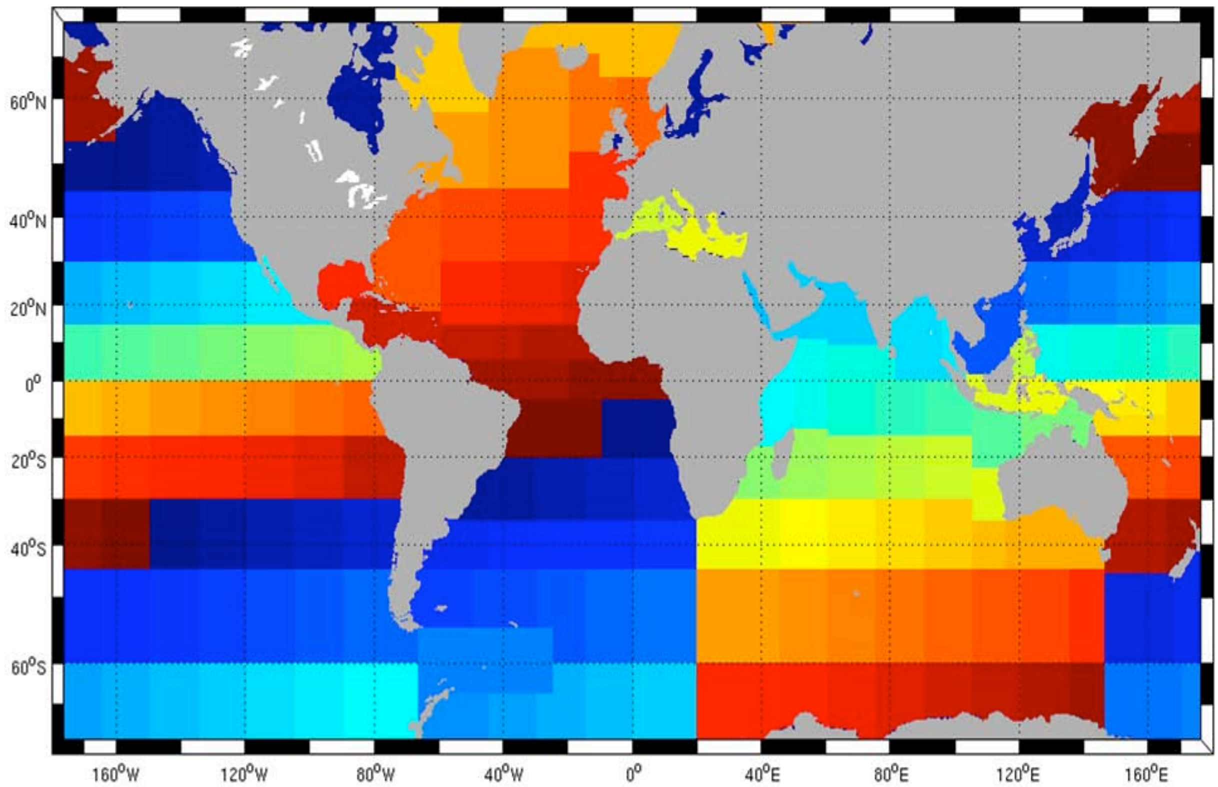
2.4 Configuration

The configuration proposed with ISAS-V4 is described in detail in (Charraudeau and Gaillard, 2007). The horizontal grid is ½ degree Mercator limited to 77S-77N. It is thus isotropic and the resolution increases with latitude, from 0.5° at equator to 0.1125° à 77N. The vertical levels are given below.



STD_LEVEL_A	[[0 3] [5:5:100] [110:10:800] [820:20:2000]]
STD_LEVEL_B	[[2020:20:2500] [2550:50:5800]]

The bathymetry is an interpolation over our grid of the file `etopo2bedmap.nc` produced by MERCATOR from the 2 minutes bathymetry file of the NGDG `Bathy_Etopo2.nc`. The interpolation is done using the median of the 4 surrounding points.



2.5 Areas and masks

For the practical implementation of the method, the global ocean has been divided in areas, that define the group of points to be processed at once. To each area, we associate a mask

defining the area where the information can be used. This allows for example to exclude the Mediterranean while analysing the Gulf of Cadiz.

2.6 The analysis steps

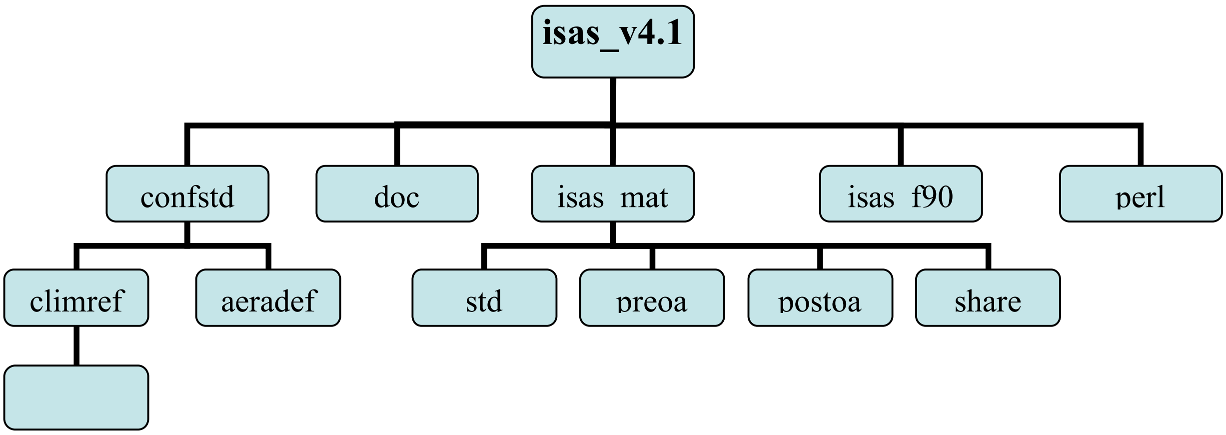
The main processing steps are:

- **STD :** Data with the valid quality control flag (QC) are selected from the raw data files and interpolated on standard levels. A new flag, representing the quality of the interpolation is associated with the each data.
- **PRE-OA :** This pre-processing step gathers all data and statistical information that will be used for the analysis of each area defined in the configuration.
- **OA**: The analysis is performed over each area as described in the 'method' section above.
- **POST-OA**: This post-processing step gathers the results over each area to form the full 3D field. Two files are produced, one holding the 3D fields and estimation error, the other holding the data and residuals.

3 The directories

3.1 program directory

This directotory contains all programs required to perform the analysis. It is organized as follows.



3.1.1 Configuration directory (confstd)

Contains all files defining the standard configurationused by the analysis (Charraudeau et Gaillard, 2007):

- Bathymetry
- Climatology (annual and monthly)
- Variances
- Covariance scales
- Definition for analysis areas and masks.

3.1.2 Documentaion directory (doc)

Contient les documentations sur la description et la mise en oeuvre des programmes.

- ISAS_V4_config.pdf
- ISAS_V4_prog.pdf

3.1.3 Matlab scripts (isas_mat)

Contains the matlab scripts used for the standardisation, the pre- and post-processing.

3.1.4 Fortran programs (isas_f90)

Contains source codes, makefile and executable for the analysis.

3.1.5 Directory perl

Contains perl script that allow to loop over different analysis dates and parameters/

3.2 The data directories

La mise en oeuvre d'ISAS se base sur quatre répertoires principaux.

- Le répertoire '**`dir_raw`**/' contient l'ensemble des données brutes fournies par Coriolis.
- Le répertoire '**`dir_confisas/`**' contient les fichiers de configuration.
- Le répertoire '**`dir_resu/`**' contient les résultats des analyses.
- Le répertoire '**`dir_run`**/' contient les alertes, tracés, fichiers log et fichiers intermédiaires des analyses.

Les deux premiers répertoires sont fournis par l'utilisateur, les deux autres sont crées par l'analyse.

3.3 Répertoire raw : les données brutes

Ce dossier est préparé par l'utilisateur et doit respecter l'organisation qui suit. Contient un sous répertoire par lot de données homogènes, issues d'un même fournisseur. A l'intérieur d'un sous répertoire, les données sont organisées par année

La dénomination des fichiers suit la convention de la documentaion Coriolis (Antonio, 2007). Un niveau 'mois/bassin' a été conservé pour assurer la compatibilité avec l'organisation précédente, mais son usage n'es pas recommandé.

3.4 Répertoire confisas

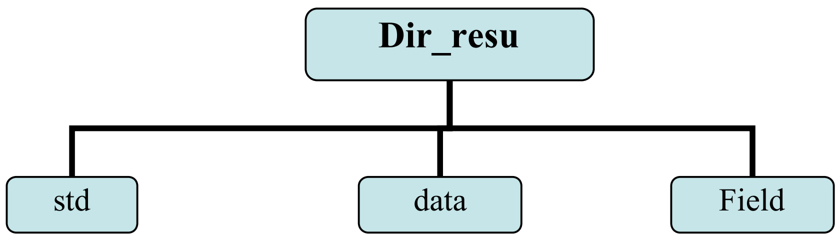
Contient le fichier de configuration de l'analyse pour définir les chemins et l'ensemble des paramètres ajustables de l'analyse. Un exemple de fichiers figure dans le répertoire **`doc/config_model`**.

- **`isas_matlab.env`** : chemins matlab
- **`oa_config_isas.txt`** : fichier de configuration définissant les paramètres des programmes matlab tel qu'il sera lu par isas_mat
- **`TEMP_6_2006.in`**, **`TEMP.cnf, PSAL.cnf :`** modèles de fichiers de configuration pour les programmes f90, à recopier dans le répertoire f90 correspondant.

3.5 Répertoire dir_resu

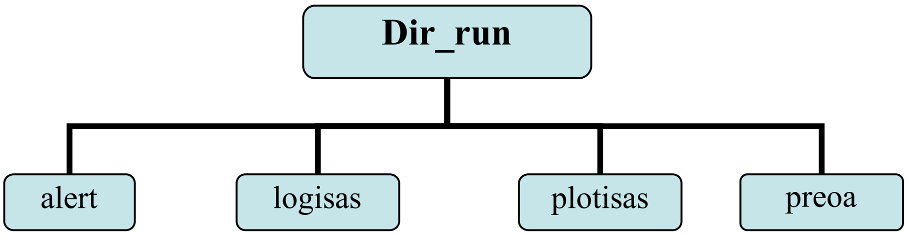
Ce répertoire contient les résultats de l'analyse. Ces résultats sont distribués dans trois sous-répertoires, chacun contenant un répertoire par année.

- **`std`** : fichiers contenant les données sur niveau standard, ces fichiers correspondent aux fichiers 'raw' mais peuvent être regroupés par mois
- **`field`** : Fichiers contenant les champs analysés sur la grille régulière
- **`data`** : fichiers contenant les données utilisées pour le calcul du champ 'field' ainsi que les résidus d'analyse.



3.6 Répertoire dir_run

Ce répertoire contient les fichiers de travail et les informations sur le déroulement de l'analyse. Ils peuvent être effacés après vérification.



- **alert** : Contient un répertoire 'list' qui regroupe les listes d'alertes émises par les différents niveaux de traitement et un répertoire 'std' qui contient les tracés des profils détectés en alerte par le programme STD_main
- **logisas** : contient les fichiers logs produits par les différentes étapes
- **plotisas** : contient les tracés produits par les différentes étapes
- **preoa** : Contient fichiers 'fld' et 'dat' par zones préparés par PREOA_main. Ces fichiers sont recopiés sur la machine de calcul où ils sont complétés.

4 Processing an anlysis

4.1 Matlab path

Before starting the analysis, the matlkab path need to be defined. The environment is described in a file `isas_matlab.env` that we recommend be placed in the directory **`confisas/`**. See **`isas_v4/doc/config`** for an example.

To launch, type:

```
cd confisas
source ISAS_matlab.env
```

```
#!/usr/bin/sh

#  ------------------------------------------------
#    Matlab directory:
#  ------------------------------------------------

setenv MATHOME      /home/machine/matlab_dir/matlab_r2007b
setenv TOOLBOXPATH  /home/machine/matlab_dir/outils_matlab/m_map1.4
setenv ISAS_HOME    /home/machine/isas_dir

setenv OA_HOME ${ISAS_HOME}/isas_v4.1/isas_mat_4.1b

setenv OA_PATH
${OA_HOME}/std:${OA_HOME}/preoa:${OA_HOME}/postoa:${OA_HOME}/share

setenv MATLABPATH ${OA_PATH}:${TOOLBOXPATH}

setenv MATLAB ${MATHOME}:${MATHOME}/bin:${MATHOME}/etc

set path=($MATLAB $path)

alias matlab  '${MATHOME}/bin/matlab'
```

4.2 Configuration file for pre- and post-processing

Before starting the analysis, the various path, file names and parameters must be defined. This is done through the configuration file: `oa_config_isas.txt`, that we recommend be placed in the directory : `confisas/`.
An example of configuration file is given in **`isas_v4/doc/config`**

```
%===========================================================================
%  Warning :
%     Lines starting with % are comment lines
%     the others are read to define the configuration, on those:
%           do not leave spaces if not required by syntax
%           do not write comments
%===========================================================================


%==============================================================

% Standart configuration : directories and file names
DIR_CONFSTD=/home/machine/dir-run/isas/isas_v4.1/confstd/
nam_clim=ISASW_4
nam_std=ISASW_52_STD
nam_bathy=bathy_GLOBAL05_V4_0.nc

% Directory for raw data
DIR_RAW_ROOT=/home7/machine/raw_data/CO_DMQCGL01/

% Directory dor standardized data
% note that a same std dataset can be used for different analysis
DIR_STD_ROOT=/home/machine/dir-run/ana/arragl03/ISAS_RESU/std/

% Directory for the analysis results
DIR_ANA_RESU=/home/machine/dir-run/ana/arragl05/ISAS_RESU/

% Directory for the analysis processing
%     (log files, plots, temporary files)
DIR_ANA_RUN=/home/machine/dir-run/ana/arragl05/ISAS_RUN/


% directory for f90
DIR_OA_CALCUL=/home2/computer/user/OA/run/arragl05/

%====================================================================

AREA_LIMITS=[-81 +80 -180 +180]


%====================================================================
%  STD: Standardisation
%====================================================================

% ocean_list: list of directories to explore
DIR_RAW_LIST=none


%   Specifique 'Coriolis'
```

```
%------------------------
% TYP_LIST: List of file types to process
TYP_LIST=PR_TE,PR_XB,PR_CT,PR_MO,PR_PF,PR_BA

% PRF_RAW   : identifier for raw files,
PRF_RAW=CO_DMQCGL01_

% PRF_STD  : identifier for STD files,
PRF_STD=ST_DMQCGL01_

% month_grp=1   : all data within a month are grouped, no group = 0
month_grp=1

% all RAW data from different basins are grouped in a single STD
% needed for compatibility with previous versions of Coriolis
% file naming convention
ocean_grp=1

% use_adjust=1  : use adjusted value if exist (else: =0)
use_adjust=0

% QC_TS: flags ok Temp and Psal
% QC_ZP: flags ok Pres and depth
%fQC_XY: flags ok Position and date
QC_TS=125
QC_ZP=0 125
QC_XY=0 125


%  Parameter for the profile control
%  ----------------------------------

% Criteria for comparing to climatology :
% crit_std_clim : number of standard deviation allowed relative to
% the climatology
%crit_std_clim=8  %  first pass
%crit_std_clim=15 %  second pass

crit_std_clim=15

% alpha_clim : Stratification correction
% A correction proportionnal to the vertical gradient is added to
% the standard deviation. If alpha_clim=0.6, we allow an additional
% 0.6*(dT/dZ or dS/dZ) distance to climatology

alpha_clim=2


% Criteria for spike detection based on second derivative
% Small value detects smaller spikes
%crit_spike_temp = 200  %     first pass
%crit_spike_psal = 200
%crit_spike_temp = 800  %     second pass
%crit_spike_psal = 800

crit_spike_temp = 800
crit_spike_psal = 800



%  INT_NB_MIN : Min number of points to perform interpolation
```

```
INT_NB_MIN=2


%  Parameters for reduction of nearby profiles
% (creates 'super profiles':
%  ----------------------------------------------
% RED_DXMAX: max distance (in km)
% RED_DTMAX: max time interval (in days)
% RED_QCMAX: QC max (defined by STD preocess) used to build
%            the superprofiles
RED_DXMAX=15
RED_DTMAX=7
RED_QCMAX=4


% Definition of default errors associated to each data type.
% will be used only if no error is specified within the raw data file
TE_ERR=0.03
BA_ERR=0.05
PF_ERR=0.01
XB_ERR=0.03
CT_ERR=0.01
MO_ERR=0.01
BH_ERR=0.002

%====================================================================


%====================================================================
%  PREOA: Preprocessing
%====================================================================

% May be used to overwrite STD name
%PRF_STD=ST_RAOAGL01_

% Instrument type excluded
%INST_EXCL_LIST=[(1:800),900] : exclude XBTs of all types
%INST_EXCL_LIST=[]
INST_EXCL_LIST=[(1:800),900]

% List of areas to be analyzed
ANA_AREA_LIST=[101:141,201:241,301:388,401:403];

%time interval (in days) (look within day – AMPL_OA and day + AMPL_OA
AMPL_OA=30

% Copies NetCDF files on the fortran computer (DIR_OA_CALCUL)
copy_preoa=1

% Creates the input file for the fortran computer
creat_in_preoa=1
%====================================================================



%====================================================================
%  POSTOA: Post-Processing
%====================================================================
% AR = Arivo, RA = Re-analysis, AT=Atlantic, X1: analysis identifier
```

```
ANA_NAME=arragl05

% Reference climatology : month or year
% clim_ref_oa=M (month) or clim_ref_oa=Y (year)
clim_ref_oa=M

% Spatial filtering on areas boundaries applied on points
% with err>err_max

filter_err_max=80

%====================================================================



%data set
DATA_SET=CO_DMQCGL01

%product version
PRODUCT_VERSION=arragl05

%Project name
PROJECT_NAME=ARIVO

%Data manager
DATA_MANAGER=Fabienne Gaillard

%plot  % Plot options(0 =no plots, 3 = maxplots + pause)
PLOT_CONV=1

LANG=En
```

4.3 Standardisation

4.3.1 Description

The first step in the analysis is an interpolation of the raw data on the standard levels of the analysis grid. It is partly independent of the analysis, in the sense that the dataset produced can be used for different analysis. A new QC is introduced, it represents the quality of the interpolation (the closest to a measured value the lowest the QC flag value).
To avoid spoiling the analysis with eroneous data, a control is performed before the interpolation. Finally, oversampled points such as repeated fixed points CTD, drfting buoys, mooring can be averaged (reduced) into super-profiles. Each of these procesing are detailled below.

4.3.1.1 Detection of erroneous data

Two different test are succesively applied:

Distance to climatology:
A data point will be accepted if the value X verifies: $|X_{obs} - X_{clim}| < \alpha_1 \, STD + \alpha_2 \, \delta X/\delta z$

- The scalar α_1 (*crit_std*in the configuration file) has been determined empirically, it defines the distance allowed to the climatology.
- The scalar α_2 introduces an additional tolerance relative to the climatology. In the vicinity of very strong stratification, perfectly good data may differ strongly from the

climatology. This is taken into account by introducing an additional tolerance proportional to the vertical gradient of the parameter.

Spike detection:
A data value is considered as a spike if the following conditions are filled:

- Change of sign of the first derivative for at least one point before or after the point.
- Second derivative criteria normalized by the median in the vicinity of the point:

$$\frac{\left|\frac{\delta^2 P}{\delta z^2}(z)\right|}{\left|mediane(\frac{\delta^2 P}{\delta z})\right|} \geq crit\_spike$$

4.3.1.2 Interpolation

The high resolution data are bin averaged on the standard levels, then the remaining levels are interpolated

4.3.1.3 Reduction (superobs)

Data from the same platform which are close in time and space are averaged. The control parameters are :

`RED_DXMAX` : Minimum distance in kilometers
`RED_DTMAX` : minimum time difference in days
`RED_QCMAX` : maximum QC-flag (after standardisation)

4.3.2 Running STD

After setting the parameters of the STD block in the configuration file, STD_main can be launched in the matlab execution window.

```
config_fname = 'my_analysis/confisas/OA_config_ISAS.txt/';

% to process 10 days starting on july 14, 2006:
dd = 14;
mm = 07;
yyyy = 2006;
nb_days = 10;

% To process a full month (ex july 2006)
dd = 0;
mm = 07;
yyyy = 2006;
nb_days = 0; % or anything, this value is ignored

STD_main (config_fname, [dd mm yyyy], nb_days);
```

An example of perl script to run STD_main over several month and years is given in
`/isas_v4/perl/std`
Type:

```
perl std.pl
```

4.3.3 Outputs

4.3.3.1 Data files on standard levels

Results are writen as NetCDF files in the directory : `dir_resu/std/`. The naming convention is as follows :
ST_CCCCCCCC_YYYYMMDD_PR_YY.nc

- ST identifies « STD » data
- CCCCCCCC dataset name
- YYYYMMDD date of observation, if day = 00, file contains the whole month
- PR identifies « profile» data
- YY data types according to Coriolis convention

4.3.3.2 Listing (log file):

The log file can be found in `dir_run /logisas/`

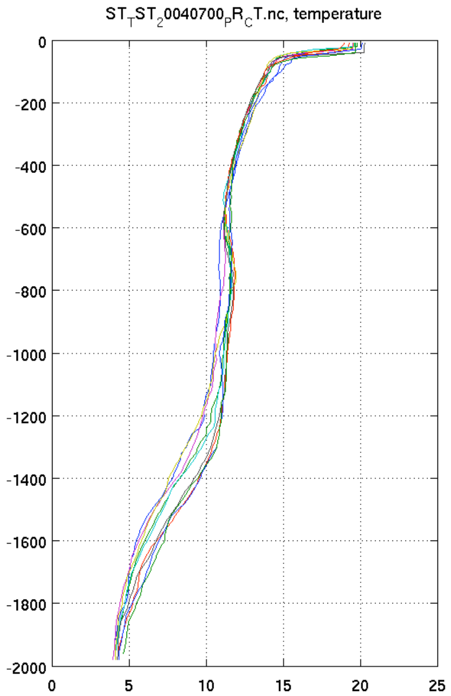
Example of log file:

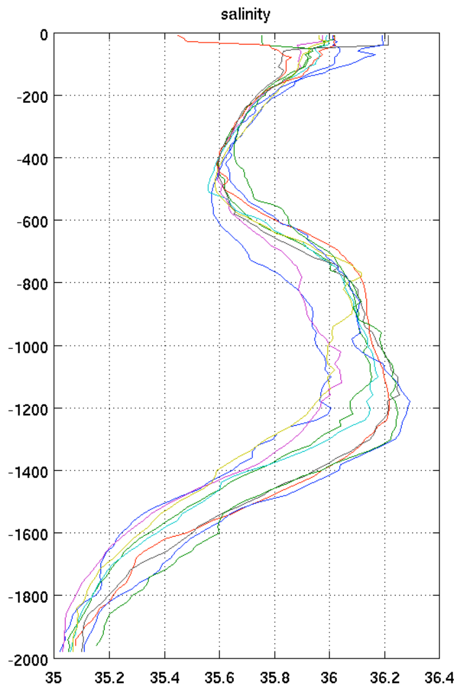
```
>>>>>>>  Running ISAS_V4.0/STD

Last update :18-Apr-2007 18:27:25

-------------------------------------
   STD: Type PR_TE,  31 files found
-------------------------------------

********  File    1  ********
File processed:    CO_TST_20040701_PR_TE
Number of profiles read :             3
Number of valid profiles (QC_posdate):3
Number of profiles kept:              3
Number of profiles per type:    T: 0, S: 0, TS: 3, total 3
Number of profiles without depth: 1
Number of profiles per type:    T: 0, S: 0, TS: 3, total 3
    3 profiles, CPU time total (seconds):  16.20
     CPU read:   1.76, depth:   1.48, STD check:  10.53, Stdlev:   1.62
…

********  File   31  ********
File processed:    CO_TST_20040731_PR_TE
Number of profiles read :             18
Number of valid profiles (QC_posdate):18
Number of profiles kept:              18
Number of profiles per type:    T: 6, S: 0, TS: 12, total 18
Number of profiles without depth: 12
Number of profiles per type:    T: 6, S: 0, TS: 12, total 18
   18 profiles, CPU time total (seconds):  18.40
     CPU read:   0.96, depth:   1.77, STD check:  14.41, Stdlev:   1.94

  112 Multiple profiles
platform:  13009    , nb_av: 2
platform:  13009    , nb_av: 2
platform:  15001    , nb_av: 2
…
platform:  CGDV     , nb_av: 3
platform:  CGDV     , nb_av: 2
Final number of profiles per type: 261     T: 35, S: 0, TS: 226
processing time - red:   1.53, prep:   0.05, write:   6.00
```

4.3.3.3 Control plots

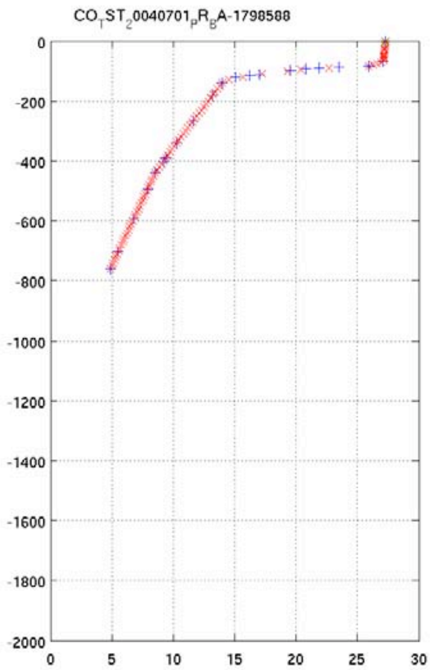
Different types of plots can be found in `dir_run/plotisas/std`.

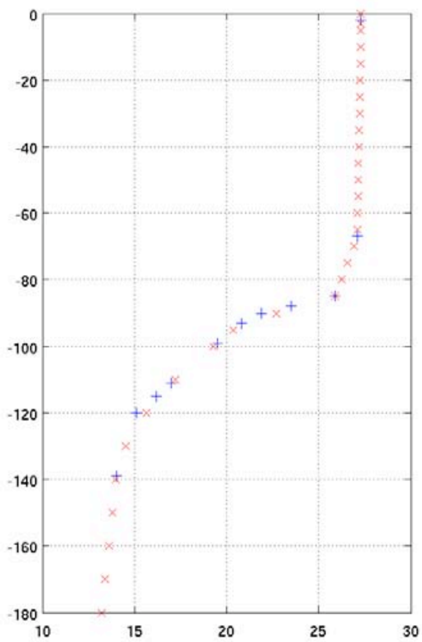
Standard plot level (`PLOT_CONV=1`) :
A plot showing all profiles is produced.





High level plot (`PLOT_CONV>1`) :



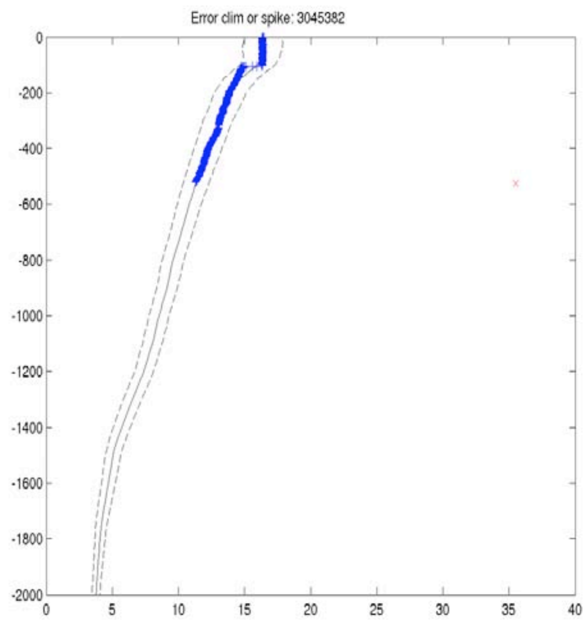


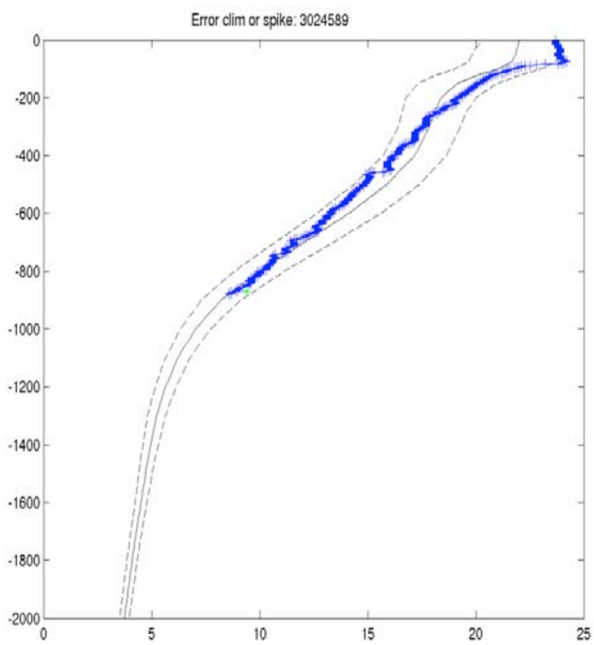
Additional plots are saved in the subdirectory 'ctrl' for one profile of the group, showing in blue the raw data, in red the interpolated data, in green the interpolated data with QC higher

than the threshold, and that will be excluded. The plot title include the name of the corresponding raw data file, and the DC_reference number.

Alertes

When data points are excluded, a plot is created in the directory : **`alert/std`** and the profile reference is added to the list in the directory **`alert/list`**.
The plot shows the temperature and salinity data points in blue, the climatology in black, the corrected standard deviation criteria as dashed line. In red, the points excluded by the climatology test and in green the points ecluded by the spike test. The plot title gives the DC-reference of the profile.





4.4 Preprocessing

PRE_OA select the data that will be used to perform the analysis over each area. All data within the area mask and the time interval defined by date +/-`AMPL_OA` are selected. At this stage, data might be excluded on the instrument type criteria (`INST_EXCL_LIST`).

4.4.1 Running preoa

After setting the parameters in the preoa block of the configuration file. Preoa can be launched in the matlab window.

```
config_fname=myanalysis/prepana/confisas/OA_config_ISAS.txt/';
PREOA_main( config_fname , [15 01 2006],'TEMP')
```

An example of perl script to run **`PREOA_main`** over several month and years is given in `/isas_v4/perl/`
Type:

```
perl preoa.pl
```

4.4.2 The output

PREOA outputs are :

- The temporary files 'fld' et 'dat' for each area, placed in the directory:
  `dir_run /preoa /`
  The 'fld' files contain the empty anomaly filed for the area on the grid. The 'dat' files contain the data to be used by the analysis.

  Naming convention are as follows :
  OA_YYYYMMDD _ iarea _typ_PARAM.nc
  - OA identifier for «optimal analyse »
  - YYYYMMDD analysis date
  - iarea area number
  - typ identifier «dat » ou « fld »
  - PARAM TEMP ou PSAL

- A copy of the 'dat' and 'fld' files in the `data/` subdirectory of `DIR_OA_CALCUL` if option `copy_preoa=1` is set in the configuration file

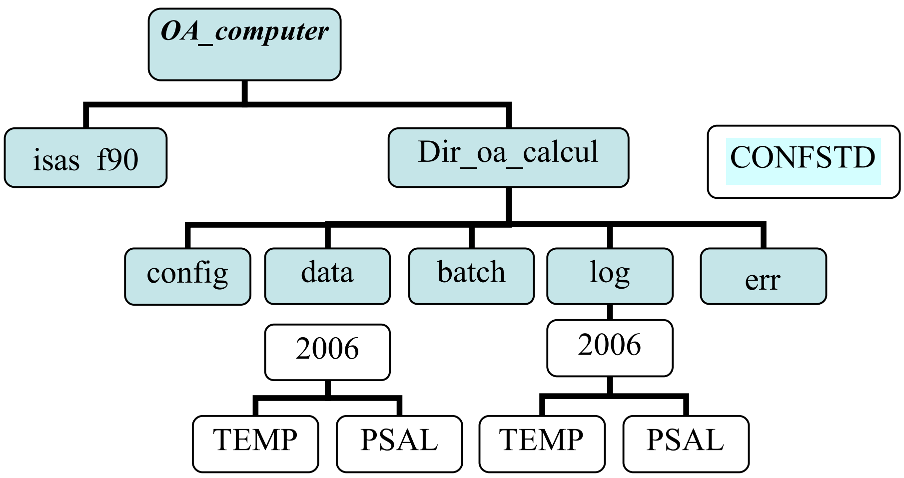
- The files TEMP.in, ou PSAL.in that contain the list of the areas to be processed. These files are created by the program `PREOA_creat_configin` and copied in the subdirectory `config` of `DIR_OA_CALCUL` if option `creat_in_preoa=1` is set in the configuration file

- A log file

Attention : Erase all files from previous runs in `preoa` directory berore running PREOA !
The process that copies the files on the fortran computer takes all files found in the directory, files from previous runs which have not been overwritten will be taken into acount and may produce inconsistencies..

4.5 Analysis

4.5.1 Subdirectories on OA-computer



4.5.1.1 Directory isas_f90

The objective analysis has been coded in fortran 90 to improve the memory use.
The source codes, makefile and executable from isas_f90 must be copied in this directory and recompiled for the computer if necessary.

4.5.1.2 Directory CONFSTD

This directory contains files for :

- the bathymetry
- the covariance scales
- the a priori variance for temperature
- the a priori variance for salinity

4.5.1.3 Analysis directory

The parent directory is named:

```
DIR_OA_CALCUL
```

4.5.1.4 config

Contains the list of area copied by PREOA for each parameter.
For example: TEMP_1_2006.in contains the list of NetCDF files to be processed:

```
data/2006/TEMP/$
log/2006/TEMP/$
config/TEMP.cnf$
164 % number of files/area to process
OA_20060101_101_dat_TEMP.nc
OA_20060101_102_dat_TEMP.nc
…
```

It should also contain the configuration file for the analysis (TEMP.cnf or PSAL.cnf)

```
TEMP
/home2/mycomputer/user/OA/run/CONFSTD/ISASW_52_STD_TEMP.nc
/home2/mycomputer/user/OA/run/CONFSTD/ISASW_4_ann_COVS.nc
/home2/mycomputer/user/OA/run/CONFSTD/bathy_GLOBAL05_V4_0.nc
300 300 21  % covar_ls  x, y t (in km, km, days)
21          % covar_ms_t (in days)
1  1  4           % var_weigh (LS, MS, UR)
1 1 0 1     % x, y, z, t covariance dependency (1 = yes, 0 = no)
1.2         % fact. Variance
2  12            % QC Max   Mx_std
1.1         % Cov_max (if > 1, no oversampling test)
3.5   11    % oversample: alpha, fct_test (Si fct_test < 10 autorise
l'augment. de l'erreur partout)
```

4.5.1.5 data

Contains the 'fld' and 'dat' files created (and optionnally copied) by `PREOA`. Those files will be completed by `OA`.

4.5.2 Running ISAS_f90

The program can be run in interactive mode :

```
cd my_analysis_f90
calculateur/isas_f90/OA_main  <  config/TEMP_2006.in
```

It can also be launched in batch mode, this allows to loop over dates and parameters.
The way batches are run is machine dependent. Examples are given here for SGI – ICE 8200.
Launch with:

```
qsub my_batch
```

where `my_batch` contains:

```
#!/bin/csh

# get the path for library MKL
source /usr/share/modules/init/csh
module load cmkl/recent
setenv MKL_SERIAL YES
cd my_analysis_f90

foreach year (2003 2004 2005 2006)
   foreach month (1 2 3 4 5 6 7 8 9 10 11 12)
      foreach param (TEMP PSAL)
            date
            calculateur/isas_f90/OA_main < config/$param\_$month\_$year\.in
            date

      end
   end
end
```

4.5.3 Outputs

4.5.3.1 err

Contains a short log file with the list of processes files and any error message issued by the program. This file must be screened carafully to chck that the processing has ended normally.

4.5.3.2 log

The log file contain statistical information on the processing for each area and each level of analysis.

```
*****   Area:  218,       Nb_profiles:    85
                             Nb_level:   152
      Nb_analysis points: (nlon,nlat):    24   28

  cpu distance calculations:  0.038

 Level:    1, Nb_ana_points:   535, Nb_ovsamp:     0, Nb_data:    58
     ano_max:  11.892, inov min:  -2.729, inov max:   1.526
                       fld  min:  -1.566, fld  max:  -0.076
     cond #   0.4999E+00,     cpu Analysis:  0.006

 Level:    2, Nb_ana_points:   535, Nb_ovsamp:     0, Nb_data:    58
     ano_max:  11.892, inov min:  -2.677, inov max:   1.478
                       fld  min:  -1.527, fld  max:  -0.096
     cond #   0.5000E+00,     cpu Analysis:  0.006
```

```
 Level:    3,...
...
   *****  cpu total area:    1.582
```

4.5.3.3 data files

The analysis results are store in the 'fld' and 'dat' data files that now contain the gridded anomaly fields and corresponding error and the data residuals, respectively.

4.6 Post-Processing

During this last part of the processing, POSTOA concatenates all processed areas and datasets. It also convert anomalies to absolute values. The files are read in `DIR_OA_CALCUL` and results are written in `DIR_ANA_RESU`
.

4.6.1 Running POSTOA

POSTOA is launched with the same arguments as PREOA :
In the matlab window :

```
config_fname=myanalysis/prepana/confisas/OA_config_ISAS.txt/';
POSTOA_main( config_fname , [15 01 2006],'TEMP')
```

Perl script are also provided.

4.6.2 Outputs

The processing can be checked looking at the log files and plots.
The results are saved in two files:

- In `{DIR_ANA_RESU}/data`, the NetcCDF 'dat' file that contains the data and residuals used by all the areas .
- In `{DIR_ANA_RESU}/field` the NetCDF file 'fld' that contains the global 3D gridded fields and error.

File naming convention are as follows :
`nameana_YYYYMMDD _ typ_PARAM.nc`

- nameana analysis identifier (`ANA_NAME` in the config file)
- YYYYMMDD analysis day
- PR identifier «dat » ou « fld »
- PARAM TEMP or PSAL

5 References

Antonio, J. 2007: Outils d’analyse de données in-situ (ISAS), formats et nomenclatures en version 3.7. Document provisoire Coriolis.

Gaillard, F. et E. Autret, 2006 : Climatologie et statistique de l’Atlantique Nord. Projet GMMC 2003.

Bretherton, F., R. Davis, and C. Fandry, (1976), A technique for objective analysis and design of oceanic experiments applied to Mode-73. *Deep Sea Research*, 23, 1B, 559--582.

Charraudeau, R. et F. Gaillard, 2007 : ISAS_V4 : Mise en place de la configuration, Rapport LPO 07-09, 88 p.

6 Annex

6.1 STD file

```
%% ncdump('ST_RAOAGL01_20020100_PR_PF.nc')   %% Generated 23-Nov-2007
10:47:32

nc = netcdf('ST_RAOAGL01_20020100_PR_PF.nc', 'noclobber');
if isempty(nc), return, end

%% Global attributes:

nc.Last_update = ncchar(''05-Nov-2007 17:01:58'');
nc.SoftwareVersion = ncchar(''ISAS_V4.03/STD'');

%% Dimensions:

nc('DATE_TIME') = 14;
nc('STRING256') = 256;
nc('STRING64') = 64;
nc('STRING32') = 32;
nc('STRING16') = 16;
nc('STRING8') = 8;
nc('STRING4') = 4;
nc('STRING2') = 2;
nc('N_PROF') = 930;
nc('N_LEVELS') = 152;
nc('RP_NB_PROF') = 995;

%% Variables and attributes:

nc{'DATA_TYPE'} = ncchar('STRING16'); %% 16 elements.
nc{'DATA_TYPE'}.comment = ncchar(''Data type'');

nc{'FORMAT_VERSION'} = ncchar('STRING4'); %% 4 elements.
nc{'FORMAT_VERSION'}.comment = ncchar(''File format version'');

nc{'REFERENCE_DATE_TIME'} = ncchar('DATE_TIME'); %% 14 elements.
nc{'REFERENCE_DATE_TIME'}.comment = ncchar(''Date of reference for Julian
days'');
nc{'REFERENCE_DATE_TIME'}.conventions = ncchar(''YYYYMMDDHHMISS'');

nc{'PI_NAME'} = ncchar('N_PROF', 'STRING64'); %% 59520 elements.
nc{'PI_NAME'}.comment = ncchar(''Name of the principal investigator'');

nc{'PLATFORM_NUMBER'} = ncchar('N_PROF', 'STRING8'); %% 7440 elements.
nc{'PLATFORM_NUMBER'}.long_name = ncchar(''Float unique identifier'');
nc{'PLATFORM_NUMBER'}.conventions = ncchar(''WMO float identifier:
QA9IIIII'');

nc{'CYCLE_NUMBER'} = nclong('N_PROF'); %% 930 elements.
nc{'CYCLE_NUMBER'}.long_name = ncchar(''Float cycle number'');
nc{'CYCLE_NUMBER'}.conventions = ncchar(''0..N, 0 : launch cycle (if
exists), 1 : first complete cycle'');
nc{'CYCLE_NUMBER'}.FillValue_ = nclong(99999);

nc{'DIRECTION'} = ncchar('N_PROF'); %% 930 elements.
```

```
nc{'DIRECTION'}.long_name = ncchar(''Direction of the station profiles'');
nc{'DIRECTION'}.conventions = ncchar(''A: ascending profiles, D: descending
profiles'');

nc{'DATA_CENTRE'} = ncchar('N_PROF', 'STRING2'); %% 1860 elements.
nc{'DATA_CENTRE'}.long_name = ncchar(''Data centre in charge of float data
processing'');
nc{'DATA_CENTRE'}.conventions = ncchar(''GTSPP table'');

nc{'DC_REFERENCE'} = ncchar('N_PROF', 'STRING32'); %% 29760 elements.
nc{'DC_REFERENCE'}.long_name = ncchar(''Station unique identifier in data
centre'');
nc{'DC_REFERENCE'}.conventions = ncchar(''Data centre convention'');

nc{'DATA_STATE_INDICATOR'} = ncchar('N_PROF', 'STRING4'); %% 3720 elements.
nc{'DATA_STATE_INDICATOR'}.long_name = ncchar(''Degree of processing the
data have passed through'');
nc{'DATA_STATE_INDICATOR'}.conventions = ncchar(''OOPC table'');

nc{'DATA_MODE'} = ncchar('N_PROF'); %% 930 elements.
nc{'DATA_MODE'}.long_name = ncchar(''Delayed mode or real time data'');
nc{'DATA_MODE'}.conventions = ncchar(''R : real time; D : delayed mode'');

nc{'INST_REFERENCE'} = ncchar('N_PROF', 'STRING64'); %% 59520 elements.
nc{'INST_REFERENCE'}.long_name = ncchar(''Instrument type'');
nc{'INST_REFERENCE'}.conventions = ncchar(''Brand, type, serial number'');

nc{'WMO_INST_TYPE'} = ncchar('N_PROF', 'STRING4'); %% 3720 elements.
nc{'WMO_INST_TYPE'}.long_name = ncchar(''Coded instrument type'');
nc{'WMO_INST_TYPE'}.conventions = ncchar(''WMO code table 1770 - instrument
type'');

nc{'JULD'} = ncdouble('N_PROF'); %% 930 elements.
nc{'JULD'}.long_name = ncchar(''Julian day (UTC) of the station relative to
REFERENCE_DATE_TIME'');
nc{'JULD'}.units = ncchar(''days since 1950-01-01 00:00:00 UTC'');
nc{'JULD'}.conventions = ncchar(''Relative julian days with decimal part
(as parts of day)'');
nc{'JULD'}.FillValue_ = ncdouble(999999);

nc{'LATITUDE'} = ncdouble('N_PROF'); %% 930 elements.
nc{'LATITUDE'}.long_name = ncchar(''Latitude of the station, best
estimate'');
nc{'LATITUDE'}.units = ncchar(''degree_north'');
nc{'LATITUDE'}.FillValue_ = ncdouble(99999);
nc{'LATITUDE'}.valid_min = ncdouble(-90);
nc{'LATITUDE'}.valid_max = ncdouble(90);

nc{'LONGITUDE'} = ncdouble('N_PROF'); %% 930 elements.
nc{'LONGITUDE'}.long_name = ncchar(''Longitude of the station, best
estimate'');
nc{'LONGITUDE'}.units = ncchar(''degree_east'');
nc{'LONGITUDE'}.FillValue_ = ncdouble(99999);
nc{'LONGITUDE'}.valid_min = ncdouble(-180);
nc{'LONGITUDE'}.valid_max = ncdouble(180);

nc{'DEPH'} = ncfloat('N_LEVELS'); %% 152 elements.
nc{'DEPH'}.long_name = ncchar(''Depth'');
nc{'DEPH'}.units = ncchar(''meter'');
nc{'DEPH'}.FillValue_ = ncfloat(99999);
nc{'DEPH'}.valid_min = ncdouble(0);
```

```
nc{'DEPH'}.valid_max = ncdouble(10000);

nc{'TEMP'} = ncfloat('N_PROF', 'N_LEVELS'); %% 141360 elements.
nc{'TEMP'}.FillValue_ = ncfloat(99999);
nc{'TEMP'}.long_name = ncchar(''Ocean temperature (T90) (interpolated on Z
levels)'');
nc{'TEMP'}.units = ncchar(''degree_Celsius'');
nc{'TEMP'}.valid_min = ncfloat(-3);
nc{'TEMP'}.valid_max = ncfloat(40);

nc{'TEMP_ERR_ME'} = ncfloat('N_PROF', 'N_LEVELS'); %% 141360 elements.
nc{'TEMP_ERR_ME'}.FillValue_ = ncfloat(99999);
nc{'TEMP_ERR_ME'}.long_name = ncchar(''Error on interpolated
temperature'');
nc{'TEMP_ERR_ME'}.units = ncchar(''degree_Celsius'');
nc{'TEMP_ERR_ME'}.valid_min = ncfloat(0.00100000004749745);
nc{'TEMP_ERR_ME'}.valid_max = ncfloat(10);

nc{'TEMP_CLIM'} = ncfloat('N_PROF', 'N_LEVELS'); %% 141360 elements.
nc{'TEMP_CLIM'}.FillValue_ = ncfloat(99999);
nc{'TEMP_CLIM'}.long_name = ncchar(''Climatology reference of profile'');
nc{'TEMP_CLIM'}.units = ncchar(''degree_Celsius'');
nc{'TEMP_CLIM'}.valid_min = ncfloat(-3);
nc{'TEMP_CLIM'}.valid_max = ncfloat(40);

nc{'TEMP_CLIM_STD'} = ncfloat('N_PROF', 'N_LEVELS'); %% 141360 elements.
nc{'TEMP_CLIM_STD'}.FillValue_ = ncfloat(99999);
nc{'TEMP_CLIM_STD'}.long_name = ncchar(''Standard deviation of climatology
reference of profile'');
nc{'TEMP_CLIM_STD'}.units = ncchar(''degree_Celsius'');
nc{'TEMP_CLIM_STD'}.valid_min = ncfloat(0);
nc{'TEMP_CLIM_STD'}.valid_max = ncfloat(40);

nc{'TEMP_QC'} = ncchar('N_PROF', 'N_LEVELS'); %% 141360 elements.
nc{'TEMP_QC'}.FillValue_ = ncchar(''0'');
nc{'TEMP_QC'}.conventions = ncchar(''Q where Q =[0-9]'');
nc{'TEMP_QC'}.long_name = ncchar(''Quality on interpolated temperature'');

nc{'PSAL'} = ncfloat('N_PROF', 'N_LEVELS'); %% 141360 elements.
nc{'PSAL'}.FillValue_ = ncfloat(99999);
nc{'PSAL'}.long_name = ncchar(''Salinity (S78) (interpolated on Z
levels)'');
nc{'PSAL'}.units = ncchar(''PSU'');
nc{'PSAL'}.valid_min = ncfloat(0);
nc{'PSAL'}.valid_max = ncfloat(60);

nc{'PSAL_ERR_ME'} = ncfloat('N_PROF', 'N_LEVELS'); %% 141360 elements.
nc{'PSAL_ERR_ME'}.FillValue_ = ncfloat(99999);
nc{'PSAL_ERR_ME'}.long_name = ncchar(''Error on interpolated salinity'');
nc{'PSAL_ERR_ME'}.units = ncchar(''PSU'');
nc{'PSAL_ERR_ME'}.valid_min = ncfloat(0.00100000004749745);
nc{'PSAL_ERR_ME'}.valid_max = ncfloat(10);

nc{'PSAL_CLIM'} = ncfloat('N_PROF', 'N_LEVELS'); %% 141360 elements.
nc{'PSAL_CLIM'}.FillValue_ = ncfloat(99999);
nc{'PSAL_CLIM'}.long_name = ncchar(''Climatology reference of profile'');
nc{'PSAL_CLIM'}.units = ncchar(''PSU'');
nc{'PSAL_CLIM'}.valid_min = ncfloat(0);
nc{'PSAL_CLIM'}.valid_max = ncfloat(60);

nc{'PSAL_CLIM_STD'} = ncfloat('N_PROF', 'N_LEVELS'); %% 141360 elements.
```

```
nc{'PSAL_CLIM_STD'}.FillValue_ = ncfloat(99999);
nc{'PSAL_CLIM_STD'}.long_name = ncchar(''Standard deviation of climatology
reference of profile'');
nc{'PSAL_CLIM_STD'}.units = ncchar(''PSU'');
nc{'PSAL_CLIM_STD'}.valid_min = ncfloat(0);
nc{'PSAL_CLIM_STD'}.valid_max = ncfloat(60);

nc{'PSAL_QC'} = ncchar('N_PROF', 'N_LEVELS'); %% 141360 elements.
nc{'PSAL_QC'}.FillValue_ = ncchar(''0'');
nc{'PSAL_QC'}.conventions = ncchar(''Q where Q =[0-9]'');
nc{'PSAL_QC'}.long_name = ncchar(''Quality on interpolated salinity'');

nc{'RP_DC_REFERENCE'} = ncchar('RP_NB_PROF', 'STRING32'); %% 31840
elements.
nc{'RP_DC_REFERENCE'}.long_name = ncchar(''DC_reference of raw profiles'');

nc{'RP_DC_REFERENCE_R'} = ncchar('RP_NB_PROF', 'STRING32'); %% 31840
elements.
nc{'RP_DC_REFERENCE_R'}.long_name = ncchar(''DC_reference of STD
profiles'');

nc{'RP_TEMP_QC_STD'} = ncchar('RP_NB_PROF'); %% 995 elements.
nc{'RP_TEMP_QC_STD'}.long_name = ncchar(''Temperature QC flag from STD '');

nc{'RP_PSAL_QC_STD'} = ncchar('RP_NB_PROF'); %% 995 elements.
nc{'RP_PSAL_QC_STD'}.long_name = ncchar(''Salinity QC flag from STD'');
```

6.2 Field file

```
%% ncdump('arragl02_20020115_fld_TEMP.nc')   %% Generated 23-Nov-2007
10:43:41

nc = netcdf('arragl02_20020115_fld_TEMP.nc', 'noclobber');
if isempty(nc), return, end

%% Global attributes:

nc.CONVENTIONS = ncchar(''COARDS'');
nc.producer_agengy = ncchar(''IFREMER'');
nc.project_name = ncchar(''ARIVO'');
nc.creation_time = ncchar(''20071123T102406'');
nc.software_version = ncchar(''ISAS_V4.0/POSTOA'');
nc.product_version = ncchar(''ARRAGL02'');
nc.data_set = ncchar(''arragl02'');
nc.data_manager = ncchar(''Fabienne Gaillard'');
nc.estimate_date = ncchar(''20020115'');
nc.south_latitude = ncchar(''-77.0105'');
nc.north_latitude = ncchar(''77.1224'');
nc.west_longitude = ncchar(''-180'');
nc.east_longitude = ncchar(''179.5'');

%% Dimensions:

nc('time') = 1;
nc('depth') = 152;
nc('latitude') = 500;
nc('longitude') = 720;

%% Variables and attributes:
```

```
nc{'time'} = ncfloat('time'); %% 1 element.
nc{'time'}.units = ncchar(''days since 1950/01/01 UTC 00:00:00'');

nc{'latitude'} = ncfloat('latitude'); %% 500 elements.
nc{'latitude'}.units = ncchar(''degree_north'');
nc{'latitude'}.valid_min = ncfloat(-90);
nc{'latitude'}.valid_max = ncfloat(90);

nc{'longitude'} = ncfloat('longitude'); %% 720 elements.
nc{'longitude'}.units = ncchar(''degree_east'');
nc{'longitude'}.valid_min = ncfloat(-180);
nc{'longitude'}.valid_max = ncfloat(180);

nc{'depth'} = ncshort('depth'); %% 152 elements.
nc{'depth'}.units = ncchar(''m'');
nc{'depth'}.positive = ncchar(''down'');
nc{'depth'}.valid_min = ncshort(0);
nc{'depth'}.valid_max = ncshort(2000);

nc{'TEMP'} = ncshort('time', 'depth', 'latitude', 'longitude'); %% 54720000
elements.
nc{'TEMP'}.long_name = ncchar(''Temperature'');
nc{'TEMP'}.units = ncchar(''degree_Celsius'');
nc{'TEMP'}.valid_min = ncfloat(-23000);
nc{'TEMP'}.valid_max = ncfloat(20000);
nc{'TEMP'}.FillValue_ = ncshort(32767);
nc{'TEMP'}.add_offset = ncfloat(20);
nc{'TEMP'}.scale_factor = ncfloat(0.00100000004749745);
nc{'TEMP'}.comment = ncchar(''Estimated by optimal interpolation'');

nc{'pct_variance'} = ncshort('time', 'depth', 'latitude', 'longitude'); %%
54720000 elements.
nc{'pct_variance'}.long_name = ncchar(''Error on temperature (percent
variance)'');
nc{'pct_variance'}.units = ncchar(''percent of a priori variance'');
nc{'pct_variance'}.valid_min = ncfloat(0);
nc{'pct_variance'}.valid_max = ncfloat(100);
nc{'pct_variance'}.FillValue_ = ncshort(32767);
nc{'pct_variance'}.add_offset = ncfloat(0);
nc{'pct_variance'}.scale_factor = ncfloat(1);
```

6.3 Data file

```
%% ncdump('arragl02_20020115_dat_TEMP.nc')   %% Generated 23-Nov-2007
10:44:44

nc = netcdf('arragl02_20020115_dat_TEMP.nc', 'noclobber');
if isempty(nc), return, end

%% Global attributes:

nc.Last_update = ncchar(''23-Nov-2007 10:23:05'');
nc.SoftwareVersion = ncchar(''ISAS_V4.0/POSTOA'');

%% Dimensions:

nc('DATE_TIME') = 14;
nc('STRING256') = 256;
nc('STRING64') = 64;
nc('STRING32') = 32;
```

```
nc('STRING16') = 16;
nc('STRING8') = 8;
nc('STRING4') = 4;
nc('STRING2') = 2;
nc('N_PROF') = 4109;
nc('N_LEVELS') = 152;
nc('RP_NB_PROF') = 4109;

%% Variables and attributes:

nc{'DATA_TYPE'} = ncchar('STRING16'); %% 16 elements.
nc{'DATA_TYPE'}.comment = ncchar(''Data type'');

nc{'FORMAT_VERSION'} = ncchar('STRING4'); %% 4 elements.
nc{'FORMAT_VERSION'}.comment = ncchar(''File format version'');

nc{'REFERENCE_DATE_TIME'} = ncchar('DATE_TIME'); %% 14 elements.
nc{'REFERENCE_DATE_TIME'}.comment = ncchar(''Date of reference for Julian
days'');
nc{'REFERENCE_DATE_TIME'}.conventions = ncchar(''YYYYMMDDHHMISS'');

nc{'PI_NAME'} = ncchar('N_PROF', 'STRING64'); %% 262976 elements.
nc{'PI_NAME'}.comment = ncchar(''Name of the principal investigator'');

nc{'PLATFORM_NUMBER'} = ncchar('N_PROF', 'STRING8'); %% 32872 elements.
nc{'PLATFORM_NUMBER'}.long_name = ncchar(''Float unique identifier'');
nc{'PLATFORM_NUMBER'}.conventions = ncchar(''WMO float identifier:
QA9IIIII'');

nc{'CYCLE_NUMBER'} = nclong('N_PROF'); %% 4109 elements.
nc{'CYCLE_NUMBER'}.long_name = ncchar(''Float cycle number'');
nc{'CYCLE_NUMBER'}.conventions = ncchar(''0..N, 0 : launch cycle (if
exists), 1 : first complete cycle'');
nc{'CYCLE_NUMBER'}.FillValue_ = nclong(99999);

nc{'DIRECTION'} = ncchar('N_PROF'); %% 4109 elements.
nc{'DIRECTION'}.long_name = ncchar(''Direction of the station profiles'');
nc{'DIRECTION'}.conventions = ncchar(''A: ascending profiles, D: descending
profiles'');

nc{'DATA_CENTRE'} = ncchar('N_PROF', 'STRING2'); %% 8218 elements.
nc{'DATA_CENTRE'}.long_name = ncchar(''Data centre in charge of float data
processing'');
nc{'DATA_CENTRE'}.conventions = ncchar(''GTSPP table'');

nc{'DC_REFERENCE'} = ncchar('N_PROF', 'STRING32'); %% 131488 elements.
nc{'DC_REFERENCE'}.long_name = ncchar(''Station unique identifier in data
centre'');
nc{'DC_REFERENCE'}.conventions = ncchar(''Data centre convention'');

nc{'DATA_STATE_INDICATOR'} = ncchar('N_PROF', 'STRING4'); %% 16436
elements.
nc{'DATA_STATE_INDICATOR'}.long_name = ncchar(''Degree of processing the
data have passed through'');
nc{'DATA_STATE_INDICATOR'}.conventions = ncchar(''OOPC table'');

nc{'DATA_MODE'} = ncchar('N_PROF'); %% 4109 elements.
nc{'DATA_MODE'}.long_name = ncchar(''Delayed mode or real time data'');
nc{'DATA_MODE'}.conventions = ncchar(''R : real time; D : delayed mode'');

nc{'INST_REFERENCE'} = ncchar('N_PROF', 'STRING64'); %% 262976 elements.
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nc{'INST_REFERENCE'}.long_name = ncchar(''Instrument type'');
nc{'INST_REFERENCE'}.conventions = ncchar(''Brand, type, serial number'');

nc{'WMO_INST_TYPE'} = ncchar('N_PROF', 'STRING4'); %% 16436 elements.
nc{'WMO_INST_TYPE'}.long_name = ncchar(''Coded instrument type'');
nc{'WMO_INST_TYPE'}.conventions = ncchar(''WMO code table 1770 - instrument
type'');

nc{'JULD'} = ncdouble('N_PROF'); %% 4109 elements.
nc{'JULD'}.long_name = ncchar(''Julian day (UTC) of the station relative to
REFERENCE_DATE_TIME'');
nc{'JULD'}.units = ncchar(''days since 1950-01-01 00:00:00 UTC'');
nc{'JULD'}.conventions = ncchar(''Relative julian days with decimal part
(as parts of day)'');
nc{'JULD'}.FillValue_ = ncdouble(999999);

nc{'LATITUDE'} = ncdouble('N_PROF'); %% 4109 elements.
nc{'LATITUDE'}.long_name = ncchar(''Latitude of the station, best
estimate'');
nc{'LATITUDE'}.units = ncchar(''degree_north'');
nc{'LATITUDE'}.FillValue_ = ncdouble(99999);
nc{'LATITUDE'}.valid_min = ncdouble(-90);
nc{'LATITUDE'}.valid_max = ncdouble(90);

nc{'LONGITUDE'} = ncdouble('N_PROF'); %% 4109 elements.
nc{'LONGITUDE'}.long_name = ncchar(''Longitude of the station, best
estimate'');
nc{'LONGITUDE'}.units = ncchar(''degree_east'');
nc{'LONGITUDE'}.FillValue_ = ncdouble(99999);
nc{'LONGITUDE'}.valid_min = ncdouble(-180);
nc{'LONGITUDE'}.valid_max = ncdouble(180);

nc{'DEPH'} = ncfloat('N_LEVELS'); %% 152 elements.
nc{'DEPH'}.long_name = ncchar(''Depth'');
nc{'DEPH'}.units = ncchar(''meter'');
nc{'DEPH'}.FillValue_ = ncfloat(99999);
nc{'DEPH'}.valid_min = ncdouble(0);
nc{'DEPH'}.valid_max = ncdouble(10000);

nc{'TEMP'} = ncfloat('N_PROF', 'N_LEVELS'); %% 624568 elements.
nc{'TEMP'}.FillValue_ = ncfloat(99999);
nc{'TEMP'}.long_name = ncchar(''Ocean temperature (T90) (interpolated on Z
levels)'');
nc{'TEMP'}.units = ncchar(''degree_Celsius'');
nc{'TEMP'}.valid_min = ncfloat(-3);
nc{'TEMP'}.valid_max = ncfloat(40);

nc{'TEMP_ERR_ME'} = ncfloat('N_PROF', 'N_LEVELS'); %% 624568 elements.
nc{'TEMP_ERR_ME'}.FillValue_ = ncfloat(99999);
nc{'TEMP_ERR_ME'}.long_name = ncchar(''Error on interpolated
temperature'');
nc{'TEMP_ERR_ME'}.units = ncchar(''degree_Celsius'');
nc{'TEMP_ERR_ME'}.valid_min = ncfloat(0.00100000004749745);
nc{'TEMP_ERR_ME'}.valid_max = ncfloat(10);

nc{'TEMP_CLIM'} = ncfloat('N_PROF', 'N_LEVELS'); %% 624568 elements.
nc{'TEMP_CLIM'}.FillValue_ = ncfloat(99999);
nc{'TEMP_CLIM'}.long_name = ncchar(''Climatology reference of profile'');
nc{'TEMP_CLIM'}.units = ncchar(''degree_Celsius'');
nc{'TEMP_CLIM'}.valid_min = ncfloat(-3);
nc{'TEMP_CLIM'}.valid_max = ncfloat(40);
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nc{'TEMP_CLIM_STD'} = ncfloat('N_PROF', 'N_LEVELS'); %% 624568 elements.
nc{'TEMP_CLIM_STD'}.FillValue_ = ncfloat(99999);
nc{'TEMP_CLIM_STD'}.long_name = ncchar(''Standard deviation of climatology
reference of profile'');
nc{'TEMP_CLIM_STD'}.units = ncchar(''degree_Celsius'');
nc{'TEMP_CLIM_STD'}.valid_min = ncfloat(0);
nc{'TEMP_CLIM_STD'}.valid_max = ncfloat(40);

nc{'TEMP_QC'} = ncchar('N_PROF', 'N_LEVELS'); %% 624568 elements.
nc{'TEMP_QC'}.FillValue_ = ncchar(''0'');
nc{'TEMP_QC'}.conventions = ncchar(''Q where Q =[0-9]'');
nc{'TEMP_QC'}.long_name = ncchar(''Quality on interpolated temperature'');

nc{'TEMP_ERR_UR'} = ncfloat('N_PROF', 'N_LEVELS'); %% 624568 elements.
nc{'TEMP_ERR_UR'}.long_name = ncchar(''Error from unresolved scales'');
nc{'TEMP_ERR_UR'}.FillValue_ = ncfloat(99999);
nc{'TEMP_ERR_UR'}.units = ncchar(''degree_Celsius'');

nc{'TEMP_RESID'} = ncfloat('N_PROF', 'N_LEVELS'); %% 624568 elements.
nc{'TEMP_RESID'}.long_name = ncchar(''Residuals'');
nc{'TEMP_RESID'}.FillValue_ = ncfloat(99999);
nc{'TEMP_RESID'}.units = ncchar(''degree_Celsius'');

nc{'RP_DC_REFERENCE'} = ncchar('RP_NB_PROF', 'STRING32'); %% 131488
elements.
nc{'RP_DC_REFERENCE'}.long_name = ncchar(''DC_reference of raw profiles'');

nc{'RP_DC_REFERENCE_R'} = ncchar('RP_NB_PROF', 'STRING32'); %% 131488
elements.
nc{'RP_DC_REFERENCE_R'}.long_name = ncchar(''DC_reference of STD
profiles'');
```